

What is claimed is:

1. A disk array system comprising:
 - a channel adapter for controlling data transfer with respect to a host device;
 - a plurality of data disk drives configuring a RAID group, at least one spare disk drive provided as a spare for the data disk drives;
 - a disk adapter for controlling data transfer with respect to the data disk drives and the spare disk drive;
 - a cache memory used by the channel adapter and the disk adapter for storing data;
 - a control memory used by the channel adapter and the disk adapter for storing control information;
 - a backup storage provided separately from the data disk drives and the spare disk drive;
 - a first control unit provided in the disk adapter for observing occurrence of access error with respect to the data disk drives, the first control unit, when the frequency of occurrence of the access error exceeds a predetermined threshold, copying data stored in the data disk drive exceeding the threshold in the spare disk drive via the cache memory;
 - a second control unit provided in the disk adapter for processing access request directed to the RAID group during the copying process by the first control unit, the second control

unit making the backup storage take over a write request directed to the RAID group; and

a third control unit provided in the disk adapter for copying data written in the backup storage by the second control unit to the data disk drives and the spare disk drive other than the data disk drive exceeding the threshold when the copying process by the first control unit is finished.

2. A disk array system according to Claim 1, wherein the second control unit processes a read request directed to the data disk drive exceeding the threshold based on the data stored in the data disk drives other than the data disk drive exceeding the threshold.

3. A disk array system according to Claim 1, wherein the second control unit processes a read request directed to the data disk drives other than the data disk drive exceeding the threshold based on data copied in the backup storage.

4. A disk array system according to Claim 1, wherein the second control unit is associated with differential management information for controlling data written in the backup storage, and determines based on the differential management information whether the read request directed to the RAID group is processed based on data stored in the data disk drives other than the

data disk drive exceeding the threshold or based on data stored in the backup storage.

5. A disk array system according to Claim 1, wherein the second control unit makes only the write request directed to the data disk drive exceeding the threshold out of write requests directed to the RAID group executed by the backup storage, and makes the write request directed to the each disk drive other than the data disk drive exceeding the threshold executed by the corresponding data disk drive.

6. A disk array system according to Claim 1, wherein the second control unit makes a write request directed to the RAID group executed by the backup storage when a space more than a predetermined value is left in the backup storage and makes the write request directed to the RAID group executed by the RAID group when a space more than the predetermined value is not left in the backup storage.

7. A disk array system according to Claim 1, wherein the first control unit recovers data in the data disk drive exceeding the threshold based on data stored in the data disk drives other than the data disk drive exceeding the threshold, and copies the recovered data to the spare disk drive.

8. A disk array system according to Claim 1 wherein a manual instruction unit for making the first control unit execute copying process is provided.

9. A disk array system according to Claim 1, wherein the first control unit and the second control unit can perform multiple operations, and the backup storage accepts write requests directed to each of the plurality of RAID groups.

10. A disk array system according to Claim 1, wherein the backup storage can be implemented as at least one of another RAID groups having the same configuration as the RAID group described above, a logical volume, or a disk drive.

11. A method of avoiding failure of a disk array system comprising a channel adapter for controlling data transfer with respect to a host device, a plurality of data disk drives configuring a RAID group, at least one spare disk drive provided as a spare for the data disk drives, a disk adapter for controlling data transfer with respect to the data disk drives and the spare disk drives, a cache memory used by the channel adapter and the disk adapter for storing data, a control memory used by the channel adapter and the disk adapter for storing control information, a backup storage provided separately from the data disk drives and the spare disk drive comprising:

a first step of observing occurrence of an access error with respect to the data disk drives and judging whether or not the frequency of occurrence of the access error exceeds a predetermine threshold;

a second step of copying data stored in the data disk drive exceeding the threshold to the spare disk drive when the data disk drive exceeding the threshold is detected in the first step;

a third step of associating the RAID group with the backup storage by starting the copying process in the first step;

a fourth step of judging whether or not an access request directed to the RAID group has issued during the copying process in the first step; and

a fifth step of writing data in the backup storage associated in the third step when issue of the access request is detected in the fourth step, and if the access request is a write request.

12. A method of avoiding failure of a disk array system according to Claim 11, further comprising a sixth step of copying data written in the backup storage in the fifth step to the each disk drive other than the data disk drive exceeding the threshold and the spare disk drive when the copying process in the second step is finished.

13. A method of avoiding failure of a disk array system according to Claim 11, wherein the fifth step comprises a step of, processing a read request based on data stored in the data disk drives other than the data disk drive exceeding the threshold when the access request detected in the fourth step is the read request directed to the data disk drive exceeding the threshold.

14. A method of avoiding failure of a disk array system according to Claim 11, wherein the fifth step determines whether the read request directed to the RAID group detected in the fourth step is processed based on data stored in the data disk drives other than the data disk drive exceeding the threshold or based on data stored in the backup storage by utilizing the differential management information for controlling data stored in the backup storage.

15. A method of avoiding failure of a disk array system according to Claim 11, wherein the fifth step makes only the write request directed to the data disk drive exceeding the threshold out of write requests directed to the RAID group detected in the fourth step executed by the backup storage, and makes a write request directed to the each disk drive other than the data disk drive exceeding the threshold executed by the corresponding data disk drive.

16. A method of avoiding failure of a disk array system according to Claim 11, wherein the second step recovers data stored in the data disk drive exceeding the threshold based on data stored in the data disk drives other than the data disk drive exceeding the threshold, and copies the recovered data to the spare disk drive.

17. A method of using a disk drive in a disk array system comprising a plurality of disk drives configuring the RAID group, comprising:

a faulty drive detecting step for observing occurrence of an access error with respect to the each disk drive configuring the RAID group, and when the frequency of the access error exceeds a predetermined threshold, determining that it is a faulty disk drive;

a data copying step for copying data stored in the faulty disk drive to a normal disk drive other than the each disk drive configuring the RAID group when the faulty disk drive is detected in the fault disk drive detecting step,

an access request detecting step for detecting whether or not an access request directed to the RAID group has issued during the copying process in the data copying step; and

an access processing step for writing data relating to the write request to a normal disk drive different from the

normal disk drive in which the data is copied when a write request is detected in the access request detecting step.

18. A method of using a disk drive in a disk array system according to Claim 17, further comprising a data update step for copying data written in the normal disk drive in the access processing step to the each disk drive configuring the RAID group other than the faulty disk drive and the normal disk drive in which the data is copied when the data copy in the data copying step is finished.

19. A method of using a disk drive in a disk array system according to Claim 17, wherein the access processing step recovers a requested data based on data stored in the each disk drive configuring the RAID group other than the faulty disk drive when a read request directed to the faulty disk drive is detected in the access request detecting step.

20. A method of using a disk drive in a disk array system according to Claim 17, wherein the data copying step restores data stored in the faulty disk drive based on data stored in the each disk drive configuring the RAID group other than the faulty disk drive and copies the recovered data to the normal disk drives.